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PATENT SPECIFICATION

DRAWINGS ATTACHED

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Date of Application and filing Complete Specification *February* 15, 1966.
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Application made in Germany (*No.* M 64529 X11/47c) *on March* 15, 1965.

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Int. Cl.: F 16 d 55/22

Improvements in or relating to hydraulic brakes.

COMPLETE SPECIFICATION

SPECIFICATION NO. 1,092,686

By a direction given under Section 17 (1) of the Patents Act 1949 this application proceeded in the name of ALFRED TEVES GESELLSCHAFT MIT BESCHRANKTER HAFTUNG, of Rebstockerstrasse 41-53, Frankfurt/Main, Germany, a Corporation organised under the laws of the Federal German Republic.

THE PATENT OFFICE

D 119992/2

brake, more particularly for motor vehicles, which has two pistons reciprocating to opposite hands in pairs of hydraulic actuating cylinders to apply brake linings to matching brake surfaces, the brake also having a mechanical brake-actuating system which acts on the pistons.

In arrangements of the kind specified, in which a mechanical brake-actuating system is provided as well as a hydraulic one, to even out brake lining wear when the brake is applied, automatic slack-adjustment has to be provided for the brake linings. The best way to do this is to advance the brake lining by an adjustable step after or possibly during each application of the brake. The automatic slack-adjustment of the brake linings has to be performed in dependence on both the hydraulic and mechanical application of the brake. Prior art systems of the kind specified are relatively complicated in construction, quite apart from the fact that in many cases slack-adjustment is performed only after hydraulic application of the brake or only after mechanical application thereof, or else special slack-adjusters have to be provided for each of these operations. Moreover, in the prior art arrangements, the slack-adjusting elements are disposed outside the pressure chamber, so that a protective cover has to be provided which is water-tight and resistant to damage, for actuating shaft into the axial braking movement of the piston, and the transmission members are connected to the piston via an adjusting drive which is completely received in the working cylinder, determines the relative positions of the piston and the transmission members axially in the cylinder, and on every occasion when the brake is applied by the agency of the actuating shaft performs an operational movement during which the adjusting drive moves the piston away from the transmission member by a step of predetermined length and advances the piston towards the matching brake surface. At the same time, for instance, a shaft-side attachment of the piston can be screwed in and out of a slack-adjusting nut which is disposed coaxially of the transmission member to rotate thereupon, but cannot move axially, and is associated with an adjusting member which is mounted for reciprocation on the transmission member, performs its reciprocation in dependence on the movement given to the transmission member by the actuating shaft, and after each portion of movement comprising a forward and a backward step turns the slack-adjusting nut by one operative step to advance the piston by one step. According to the invention slack-adjustment is automatically performed in both the hydraulic and mechanical opera-

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Improvements in or relating to hydraulic brakes.

COMPLETE SPECIFICATION

We, HEINZ TEVES, ERNST AUGUST TEVES and MARTIN TAUSEND all of German nationality trading as ALFRED TEVES MASCHINEN- UND ARMATURENFABRIK KOMMANDIT-GESELLSCHAFT, of Rebstocker-Strasse 41-53, Frankfurt/Main, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a hydraulic brake, more particularly for motor vehicles, which has two pistons reciprocating to opposite hands in pairs of hydraulic actuating cylinders to apply brake linings to matching brake surfaces, the brake also having a mechanical brake-actuating system which acts on the pistons.

In arrangements of the kind specified, in which a mechanical brake-actuating system is provided as well as a hydraulic one, to even out brake lining wear when the brake is applied, automatic slack-adjustment has to be provided for the brake linings. The best way to do this is to advance the brake lining by an adjustable step after or possibly during each application of the brake. The automatic slack-adjustment of the brake linings has to be performed in dependence on both the hydraulic and mechanical application of the brake. Prior art systems of the kind specified are relatively complicated in construction, quite apart from the fact that in many cases slack-adjustment is performed only after hydraulic application of the brake or only after mechanical application thereof, or else special slack-adjusters have to be provided for each of these operations. Moreover, in the prior art arrangements, the slack-adjusting elements are disposed outside the pressure chamber, so that a protective cover has to be provided which is water-tight and resistant to damage, for instance, from flying pebbles or the like.

To this end, according to the invention, the brake-actuating system comprises on the one hand an actuating shaft which is introduced laterally into the working cylinder and has a geometrical axis extending transversely of the direction of axial braking movement of the piston in the working cylinder, and on the other hand, transmission members which are connected between the actuating shaft and the pistons to convert the rotary movement of the actuating shaft into the axial braking movement of the piston, and the transmission members are connected to the piston via an adjusting drive which is completely received in the working cylinder, determines the relative positions of the piston and the transmission members axially in the cylinder, and on every occasion when the brake is applied by the agency of the actuating shaft performs an operational movement during which the adjusting drive moves the piston away from the transmission member by a step of predetermined length and advances the piston towards the matching brake surface. At the same time, for instance, a shaft-side attachment of the piston can be screwed in and out of a slack-adjusting nut which is disposed coaxially of the transmission member to rotate thereupon, but cannot move axially, and is associated with an adjusting member which is mounted for reciprocation on the transmission member, performs its reciprocation in dependence on the movement given to the transmission member by the actuating shaft, and after each portion of movement comprising a forward and a backward step turns the slack-adjusting nut by one operative step to advance the piston by one step. According to the invention slack-adjustment is automatically performed in both the hydraulic and mechanical opera-

tion of the brake. This is achieved by a very simple construction of the whole system. Moreover, in the arrangement according to the invention, the slack-adjusting elements, which are generally very sensitive, are disposed inside the working cylinder pressure chamber and are therefore protected from dirt, weather and damage.

An embodiment of the invention is illustrated in the drawings, wherein:

Fig. 1 is a side elevation, in vertical section, of the arrangement according to the invention,

Fig. 1*a* is a detail of the arrangement in Fig. 1, shown during a different stage of brake movement,

Fig. 2 is a sectional plan of the arrangement shown in Fig. 1, and

Fig. 2*a* is a diagrammatic front elevation of a detail of the arrangement shown in Fig. 2.

The hydraulic brake according to the invention, which is more particularly suited to motor vehicles, has in known manner two pistons 2 reciprocating to opposite hands in hydraulic working cylinders 1 to apply a brake lining to a matching brake surface. Associated with the hydraulic brake system in known manner is a mechanical brake-actuating system which acts on the pistons via a manually-applied hand brake lever.

According to the invention the mechanical brake-actuating system comprises on the one hand an actuating shaft 3 which is laterally introduced into the working cylinder and whose geometrical axis 5 extends transversely of the axial braking movement of the piston, as shown by an arrow 4, and on the other hand one or more transmission members 6 which is or are connected between the actuating shaft 3 and the piston 2 to convert the rotary movement of the actuating shaft into the axial braking movement of the piston. The transmission members and the piston are interconnected via an adjusting drive 7, 8 which is completely received in a pressure chamber 9 of the working cylinder 1 and every time the brake is applied performs, urged by the actuating shaft, an operative movement during which the adjusting drive moves the piston away from the transmission member by a step of predetermined amount and advances the piston towards the matching brake surface.

The piston has on its side facing the actuating shaft a screwthreaded attachment 2*a* which is coaxial with a projection 10 of the transmission member on its side remote from the actuating shaft, and has substantially the same diameter as the projection 10. Screwed to the attachment 2*a* is a sleeve-like internally screwthreaded slack-adjusting nut 7 which is mounted to rotate on projection 10. The slack-adjusting nut cannot move axially on the projection 10 since the nut is prevented from doing so by a clamping sleeve 12 engaging in a groove 11. Associated with the slack-adjusting nut is an adjusting member 8 mounted to pivot backwards and forwards on the transmission member in the direction indicated by the curved arrow in Fig. 2. The adjusting member pivots and reciprocates in dependence on the movement of the transmission member urged by the actuating shaft 3, the arrangement being such that after each portion of movement the slack-adjusting nut is rotated by a further operative step and advances the piston by one step. To this end the slack-adjusting nut bears a coaxial adjusting wheel 13 whose periphery is toothed, for instance, as shown in Fig. 2*a*. The adjusting member has an actuating arm 14, a lever arm 15 and a resilient arm 16. The actuating arm extends to above the periphery of the adjusting wheel 13 in a plane extending tangentially thereto. The lever arm 15 extends substantially transversely of the advance movement of the transmission member and the piston and is received together with the lever arm in a common plane extending tangentially to the periphery of the adjusting wheel. The resilient arm 16 bears from outside against the periphery of the slack-adjusting nut 7 in a plane extending parallel with that of the actuating arm and the lever arm, to which end the resilient arm 16 is disposed on an attachment 17 engaging laterally downwards around the slack-adjusting nut 7. According to the invention, when the transmission member moves and therefore the nut 7 moves in the direction indicated by the arrow 4 the lever arm 15 abuts a stop 18 which is fixed in the working cylinder wall and extends into the pressure chamber 9. During the forward movement, as indicated by the arrow 4, the lever arm 15 abuts the stop 18 to pivot the lever arm 15 around the axis 19, so that the actuating arm 14 pivots correspondingly. Also according to the invention, as the actuating arm 14 moves forward in correspondence with the movement of the piston into the braking position the actuating arm 14 jumps over the teeth of the adjusting wheel, but during its subsequent return movement the actuating arm 14 engages in the teeth of the adjusting wheel and rotates the same together with the nut 7. In the embodiment illustrated in Figs. 1 and 2 the screwthreaded attachment of the piston has a right-hand thread, and the fixed stop 18 is disposed between the lever arm of the adjusting member and the matching brake surface. The lever arm 15 and the actuating arm 14 form an angle of less than 180° in the clockwise direction. When a movement is made in the direction indicated by the arrow 4, after the lever arm 15 has abutted the stop 18 the lever arm 15 is pivoted

clockwise so that the actuating arm 14 is also pivoted clockwise, as indicated by an arrow 19′ in Fig. 2*a*. Fig. 2*a* shows how the actuating arm 14 jumps over the teeth of the adjusting wheel 13. Since the screwthread is self-locking, the slack-adjusting nut 7 does not rotate. When the actuating arm 14 moves clockwise the resilient arm 16 is stressed. As soon as the advance movement caused by the mechanical or hydraulic operation of the brake ceases and therefore the pressure chamber 9 is depressurised, the piston moves back merely as a result of the rolling effect; moreover, the resilient arm 16 is released to move the actuating arm anticlockwise, so that the actuating arm 14 jumps behind the next tooth of the adjusting wheel 13 and rotates the same by one tooth in an anticlockwise direction, as indicated by an arrow 20. Since the screwthreaded attachment has a right-hand thread, the screwthreaded attachment and the piston, and therefore the brake lining 21′ which is connected to the piston via a plate 22′, are advanced by one step. If the screwthreaded attachment of the piston has a left-hand thread, the lever arm must form with the actuating arm of the adjusting member an angle of less than 180° in the anticlockwise direction. Exactly the same effect is produced. If with the arrangement of the lever arm 15 illustrated in Fig. 2, the screwthreaded attachment has a left-hand thread, the piston is advanced as soon as the brake is operated. Since the screwthreading is self-locking, when the brake is released the slack-adjusting nut does not rotate, while the adjusting member returns to its starting position and jumps behind the next tooth of the adjusting wheel.

In the embodiment illustrated in the drawings the actuating shaft 3 is pivotably mounted at both ends at opposite places 21, 22 on the wall of the working cylinder 1, the central portion of the actuating shaft 3 inside the cylinder having a flattened peripheral surface portion 24 by which the shaft bears against a correspondingly shaped matching surface 25 of the transmission member disposed between the shaft and the piston. The flattened peripheral surface portion is provided in a milled or cut-away portion 26 of the actuating shaft and has a width B slightly exceeding the diameter D of the cylindrical transmission member. The milled or cut-away portion of the actuating shaft is received in a recess 27 in the transmission member which is open on the side remote from the piston and has a rectangular cross-section whose height H is somewhat larger than the diameter *d* of the actuating shaft. Conveniently, the actuating shaft is connected at both ends to an actuating member 28 by which the shaft can be rotated from the hand brake, for instance, by a Bowden cable. When rotated in the direction indicated by an arrow 29, the actuating shaft moves into the position shown in Fig. 1*a*, in which an edge 30 of the shaft moves the transmission member in the direction indicated by the arrow 4. The movement of the transmission member causes, via the slack-adjusting nut, a corresponding axial movement of the piston attachment, and also causes the various arms of the adjusting member to pivot, so that the piston is adjusted in the manner described hereinbefore.

When the brake linings become worn and have to be interchanged, the piston can be screwed back into the slack-adjusting nut by means of a special tool known as piston-rotating pliers which engage in recesses 41, 42. None of the hydraulic fluid is lost.

The construction can also be used as a piston-return lock to prevent the piston from moving away from the brake disc and forcing the brake fluid back into the compensating reservoir of the brake system, an event which might mean that the next time the brake was hydraulically applied the pedal would have to be depressed as far as it would go.

WHAT WE CLAIM IS:—

1. A hydraulic brake, more particularly for motor vehicles, which has two pistons reciprocating to opposite hands in pairs of hydraulic actuating cylinders to apply brake linings to matching brake surfaces, the brake also having a mechanical brake-actuating system which acts on the pistons, wherein the brake-actuating system comprises on the one hand an actuating shaft which is introduced laterally into the working cylinder and has a geometrical axis extending transversely of the direction of axial braking movement of the piston in the working cylinder, and on the other hand, transmission members which are connected between the actuating shaft and the piston to convert the rotary movement of the actuating shaft into the axial braking movement of the piston, and the transmission members are connected to the piston via an adjusting drive which is completely received in the working cylinder, determines the relative positions of the piston and the transmission members axially in the cylinder, and on every occasion when the brake is applied by the agency of the actuating shaft performs an operational movement during which the adjusting drive moves the piston away from the transmission member by a step of predetermined length and advances the piston towards the matching brake surface.

2. A hydraulic brake as set forth in claim 1 wherein an attachment of the piston on its side facing the actuating shaft can be

screwed in and out of a slack-adjusting nut which is disposed coaxially of the transmission member to rotate thereupon, but cannot move axially, and is associated with an adjusting member which is mounted for reciprocation on the transmission member, performs its reciprocation in dependence on the movement given to the transmission member by the actuating shaft, and after each portion of movement comprising a forward and a backward step turns the slack-adjusting nut by one operative step to advance the piston by one step.

3. A hydraulic brake as set forth in claim 2 wherein the slack-adjusting nut bears a coaxial adjusting wheel which cooperates with an actuating arm of the adjusting member and whose periphery is so toothed that during the advance movement of the adjusting member corresponding to the movement of the piston into the braking position an operating arm on the adjusting member jumps over the teeth, but during the subsequent return movement of the adjusting member engages in the teeth of the adjusting wheel and correspondingly rotates the same together with the nut.

4. A hydraulic brake as set forth in claim 3 wherein the actuating arm of the adjusting member is adjustably mounted in a plane extending tangentially of the periphery of the adjusting wheel.

5. A hydraulic brake as set forth in claim 3 or 4 wherein the actuating arm of the adjusting member is mounted to rotate around an axis extending radially of the actuating shaft.

6. A hydraulic brake as set forth in claims 4 or 5 wherein the adjusting member, which is mounted to rotate on the periphery of the transmission member adjustable in either direction inside the working cylinder and moves axially together with the transmission member, has in addition to the actuating arm extending in the direction of the adjusting wheel a lever arm which extends substantially transversely of the direction of movement of the transmission member and in the pivoting plane of the adjusting member and with which a fixed stop is associated which projects into the cylinder and which the lever arm abuts during the advance movement of the transmission member, thus rotating the adjusting member in co-operation with the lever arm.

7. A hydraulic brake as set forth in claim 6 wherein the adjusting member has a, for instance, leaf-spring-like resilient arm which bears against the periphery of the slack-adjusting nut, is stressed during the movement of the adjusting member corresponding to the advance movement of the transmission member and is thereafter released to return the adjusting member.

8. A hydraulic brake as set forth in claim 7 wherein the actuating arm and the lever arm of the adjusting member are received in a common plane extending substantially tangentially to the periphery of the adjusting wheel, the actuating arm extending longitudinally of the transmission member and in the direction of braking movement, the lever arm extending substantially transversely thereof, and the resilient arm, which extends substantially parallel with the actuating arm and is in a plane parallel with that of the actuating arm and the lever arm, is disposed on an adjusting member attachment engaging laterally around the slack-adjusting nut.

9. A hydraulic brake as set forth in claim 8 wherein the screwthreaded attachment of the piston facing the pressure chamber is coaxial with a projection of substantially the same diameter which is disposed on the side of the transmission member remote from the actuating shaft and on which the sleeve-like internally screwthreaded slack-adjusting nut is mounted for rotation, for instance, by means of a clamping sleeve and a groove, but cannot move axially, the screwthreaded attachment of the piston being screwed into the slack-adjusting nut.

10. A hydraulic brake as set forth in claim 9 wherein the screwthreaded attachment of the piston has a right-hand thread, the fixed, for instance, pin-shaped stop on the working cylinder wall is disposed between the lever arm of the adjusting member and the matching brake surface, and the lever arm forms on the adjusting member an angle of 180° in the clockwise direction with the actuating arm.

11. A hydraulic brake as set forth in claim 9 wherein the screwthreaded attachment of the piston has a left-hand thread, the fixed, for instance, pin-shaped stop on the working cylinder wall is disposed between the lever arm of the adjusting member and the matching brake surface, and the lever arm forms on the adjusting member an angle of less than 180° in the anticlockwise direction with the actuating arm.

12. A hydraulic brake as set forth in one of claims 1-11 wherein the actuating shaft is pivotably mounted at both ends at opposite places on the working cylinder wall, and its part inside the cylinder has a flattened peripheral surface portion by which the actuating shaft engages with a correspondingly shaped matching surface on the transmission member provided between the actuating shaft and the piston.

13. A hydraulic brake as set forth in claim 12 wherein the flattened peripheral surface portion is provided in a milled or cut-out portion of the actuating shaft having a width slightly exceeding the diameter of the transmission member, and the cut or milled-out portion of the actuating shaft is

received in an open recess with which that side of the conveniently cylindrical transmission member remote from the piston is formed and which has a rectangular cross-section whose height is greater than the diameter of the actuating shaft, and an actuating member operates on at least one end projecting from the working cylinder, but conveniently on both ends, so that the actuating shaft can be rotated from the hand brake lever, for instance, via a Bowden cable.

14. A hydraulic brake as set forth in one of claims 1—13 wherein the mechanical brake-actuating system also acts as a return lock for the piston to prevent the same from moving away from the matching brake surface.

15. A hydraulic brake, more particularly for motor vehicles substantially as hereinbefore described and substantially as illustrated in the accompanying drawings.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG.1.

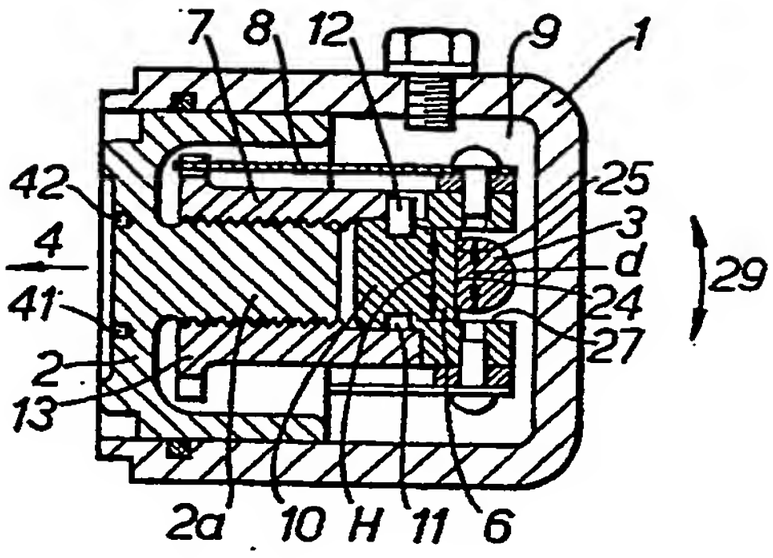

FIG.1a.

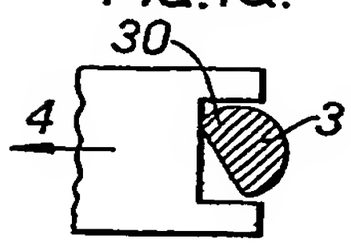

FIG.2a.

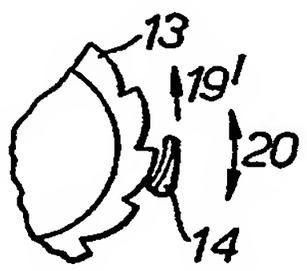

FIG.2.